

## Comparison of Anastomotic Suturing Techniques in the Rat Trachea

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**Background:** Tracheal resection is the preferred treatment for primary tracheal tumors. Anastomotic tension can be a problem, even when various tension-relieving release maneuvers are employed. Excessive tension can cause anastomotic sutures to pull through the tracheal tissue, with resultant early tracheal anastomotic dehiscence. To test the hypothesis that interrupted horizontal mattress sutures would withstand the forces of tension better than interrupted simple sutures, an experimental study of rat tracheal anastomoses was done.

**Methods:** Twenty rats were killed and their tracheas excised. The tracheas were divided in the mid portion and end to end anastomoses were done using interrupted 7-0 polypropylene sutures. Ten tracheas had anastomoses done with interrupted simple sutures, and 10 had interrupted horizontal mattress suturing.

**Results:** Anastomotic breaking strength was  $2.30 \pm 0.57$  N for the interrupted simple sutured anastomoses and  $2.15 \pm 0.48$  N for the interrupted horizontal mattress group ( $P = 0.54$ ). The difference was not significant.

**Conclusions:** In this animal study, interrupted simple and horizontal mattress suturing withstood the disruptive forces of anastomotic tension equally well. © 1996 Wiley-Liss, Inc.

**KEY WORDS:** trachea, wound healing, suture techniques

### INTRODUCTION

Tracheal resection is the treatment of choice for operable primary tracheal tumors. Clinical experience has shown that tracheal end-to-end anastomosis is preferable to attempts at prosthetic reconstruction of the trachea. Even if long segments of the trachea are excised, end-to-end anastomoses can usually be done if various techniques of tracheal mobilization are used to relieve tension [1]. Nevertheless, excess tension and its detrimental effect on anastomotic healing are sometimes unavoidable. Early anastomotic dehiscence is a catastrophic complication that results from anastomotic sutures pulling through the tracheal tissues [2]. We have had favorable clinical experience with horizontal mattress suturing in situations in which tracheal anastomotic tension was considered excessive, but unavoidable. On the basis of this anecdotal clinical experience, and knowledge of wound suturing techniques in other tissues, we hypothesized that interrupted horizontal mattress sutures would have greater resistance to early anastomotic disruption than would traditional

interrupted simple sutures. An experimental study comparing these two suturing techniques in the rat trachea was done.

### MATERIALS AND METHODS

Twenty female Sprague-Dawley rats, weighing 200–250 g, were killed by a lethal intraperitoneal injection of pentobarbital sodium (120 mg/kg). The tracheas were excised and divided transversely in their middle portion. End-to-end anastomoses were done using interrupted 7-0 polypropylene sutures that incorporated one tracheal ring on each side of the anastomosis. In 10 tracheas, interrupted simple sutures were placed; in the other 10 tracheas, interrupted horizontal mattress sutures were used.

The tracheal anastomoses were tested for their ability

Accepted for publication August 27, 1996.

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to withstand the disruptive action of tension. Tracheas were mounted in an Instron mini-44 tensiometer (Canton, MA) and distracted at 10 mm/min. Peak breaking strength was measured in Newtons (N).

Breaking strength data are presented as means  $\pm$  SD. A two-tailed Student's *t*-test was used to assess differences in means between the two experimental groups.  $P < 0.05$  was taken to indicate a significant difference.

## RESULTS

Anastomoses sutured with interrupted simple sutures had a breaking strength of  $2.30 \pm 0.57$  N; those sutured with interrupted horizontal mattress sutures had a breaking strength of  $2.15 \pm 0.48$  N ( $P = 0.54$ ). The difference was not significant. The usual pattern of wound disruption was characterized by separation of one of the para-anastomotic tracheal rings from the remaining trachea, as opposed to sutures cutting through the cartilaginous tracheal rings. There were no instances of suture breakage or knot failure.

## DISCUSSION AND CONCLUSIONS

Tracheal anastomoses can disrupt very early, from technical errors or excessive tension, or several days after surgery, from anastomotic ischemia and infection [2]. Our experiment was designed to address the infrequent, but catastrophic, problem of early tracheal disruption secondary to excessive tension. In this circumstance, the mechanism of anastomotic dehiscence is one of sutures cutting through the tracheal tissue. Breakage of sutures and knot failure are rare, and entirely preventable, causes of early dehiscence.

Tracheal anastomoses are usually done using interrupted simple sutures [1]. Clinical experience with this

technique has been favorable. Bronchial anastomotic suturing in lung transplantation is similar in many respects to tracheal anastomotic suturing. The "telescoping" anastomotic technique, which uses horizontal mattress sutures, is now an accepted technique for bronchial anastomosis in lung transplant [3]. Horizontal mattress suturing, without telescoping, could have some advantage over simple sutures in tracheal anastomoses. We hypothesized that horizontal mattress sutures would withstand tension better than simple sutures. In other wounds subjected to excessive tension, such as tendon repairs, various types of mattress sutures are superior to simple sutures; they are less likely to cut through the tissues when the wound is subjected to forces of tension [4].

The experimental results show that tracheal anastomoses done with horizontal mattress sutures do not resist tension better than anastomoses done with simple sutures. Tracheal anastomoses are unique as compared to other wounds exposed to tension during healing; tracheal tissue is not homogeneous. This may explain why the mattress sutures were not beneficial. In this rat trachea model, wound failure usually occurred in the inter-ring tracheal tissue, irrespective of the suturing technique.

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